

# Claims

- [c1] 1. A method of fabricating a polysilicon film, comprising:
- providing a substrate;
  - forming an insulating layer, a first amorphous silicon layer and a cap layer over the substrate;
  - performing a first annealing to transform the first amorphous silicon layer into a first polysilicon layer with at least a hole;
  - removing the cap layer;
  - removing a portion of the insulating layer within the hole to form a first opening within the insulating layer, wherein the hole and the first opening constitute a second opening;
  - forming a second amorphous silicon layer over the first polysilicon layer and filling the second opening, wherein a recess is formed over a portion of the second amorphous silicon layer over the second opening; and
  - performing a second annealing and forming a second polysilicon layer by partially fusing the second amorphous silicon layer and the first polysilicon layer, and taking an unfused portion of the second amorphous silicon layer as seeds for crystallization.

- [c2] 2. The method of fabricating a polysilicon film as recited in claim 1, wherein the cap layer comprises silicon dioxide.
- [c3] 3. The method of fabricating a polysilicon film as recited in claim 1, wherein the step of performing the first annealing comprises performing an excimer laser annealing process.
- [c4] 4. The method of fabricating a polysilicon film as recited in claim 1, wherein the step of removing the portion of the insulating layer within the hole comprises performing a wet etching using a solution containing hydrofluoric acid.
- [c5] 5. The method of fabricating a polysilicon film as recited in claim 1, wherein the step of performing the second annealing comprises performing an excimer laser annealing process.
- [c6] 6. The method of fabricating a polysilicon film as recited in claim 1, wherein a width of the second opening is smaller than one micron.
- [c7] 7. A method of fabricating a polysilicon film, comprising:  
providing a substrate;  
forming an insulating layer, a first amorphous silicon layer, and a cap layer over the substrate;

performing a first annealing to transform the first amorphous silicon layer into a first polysilicon layer with at least a hole;  
removing the cap layer;  
removing a portion of the insulating layer within the hole to form a first opening within the insulating layer, wherein the hole and the first opening constitute a second opening;  
forming a dielectric layer over the first polysilicon layer and filling the second opening, wherein a recess is formed over a portion of the dielectric layer above the second opening;  
forming a second amorphous silicon layer over the dielectric layer; and  
performing a second annealing and transforming the second amorphous silicon layer into a second polysilicon layer by taking a portion of the second amorphous silicon layer within the recess as seeds for crystallization.

[c8] 8. The method of fabricating a polysilicon film as recited in claim 7, wherein the cap layer comprises silicon dioxide.

[c9] 9. The method of fabricating a polysilicon film as recited in claim 7, wherein the step of performing the first annealing process comprises an excimer laser annealing process.

- [c10] 10. The method of fabricating a polysilicon film as recited in claim 7, wherein the step of removing the portion of the insulating layer within the hole comprises performing a wet etching using a solution containing hydrofluoric acid.
- [c11] 11. The method of fabricating a polysilicon film as recited in claim 7, wherein the step of performing the second annealing comprises performing an excimer laser annealing process.
- [c12] 12. The method of fabricating a polysilicon film as recited in claim 7, wherein the dielectric layer comprises silicon dioxide.
- [c13] 13. The method of fabricating a polysilicon film as recited in claim 7, wherein a width of the second opening is smaller than one micron.
- [c14] 14. A method of fabricating a polysilicon film, comprising:  
providing a substrate;  
forming an insulating layer, a first amorphous silicon layer and a cap layer over the substrate;  
performing a first annealing to transform the first amorphous silicon layer into a first polysilicon layer with at least a first hole;

removing the cap layer;  
removing a portion of the insulating layer within the first hole to form a first opening within the insulating layer, wherein the first hole and the first opening constitute a second opening;  
forming a dielectric layer over the first polysilicon layer and filling the second opening, wherein the dielectric layer surrounds a second hole within the second opening;  
forming a second amorphous silicon layer over the dielectric layer; and  
performing a second annealing and transforming the second amorphous silicon layer into a second polysilicon layer, wherein a portion of the second amorphous silicon layer over the second hole is subjected to a higher temperature than other portion of the second amorphous silicon layer relative to the second hole.

[c15] 15. The method of fabricating a polysilicon film as recited in claim 14, wherein the cap layer comprises silicon dioxide.

[c16] 16. The method of fabricating a polysilicon film as recited in claim 14, wherein the step of performing the first annealing comprises performing an excimer laser annealing process.

- [c17] 17. The method of fabricating a polysilicon film as recited in claim 14, wherein the step of removing the portion of the insulating layer within the first hole comprises performing a wet etching using a solution containing hydrofluoric acid.
- [c18] 18. The method of fabricating a polysilicon film as recited in claim 14, wherein the step of performing the second annealing comprises performing an excimer laser annealing.
- [c19] 19. The method of fabricating a polysilicon film as recited in claim 14, wherein the dielectric layer comprises silicon dioxide.
- [c20] 20. The method of fabricating a polysilicon film as recited in claim 14, wherein a width of the second opening is smaller than one micron.